Institut de la statistique du Québec

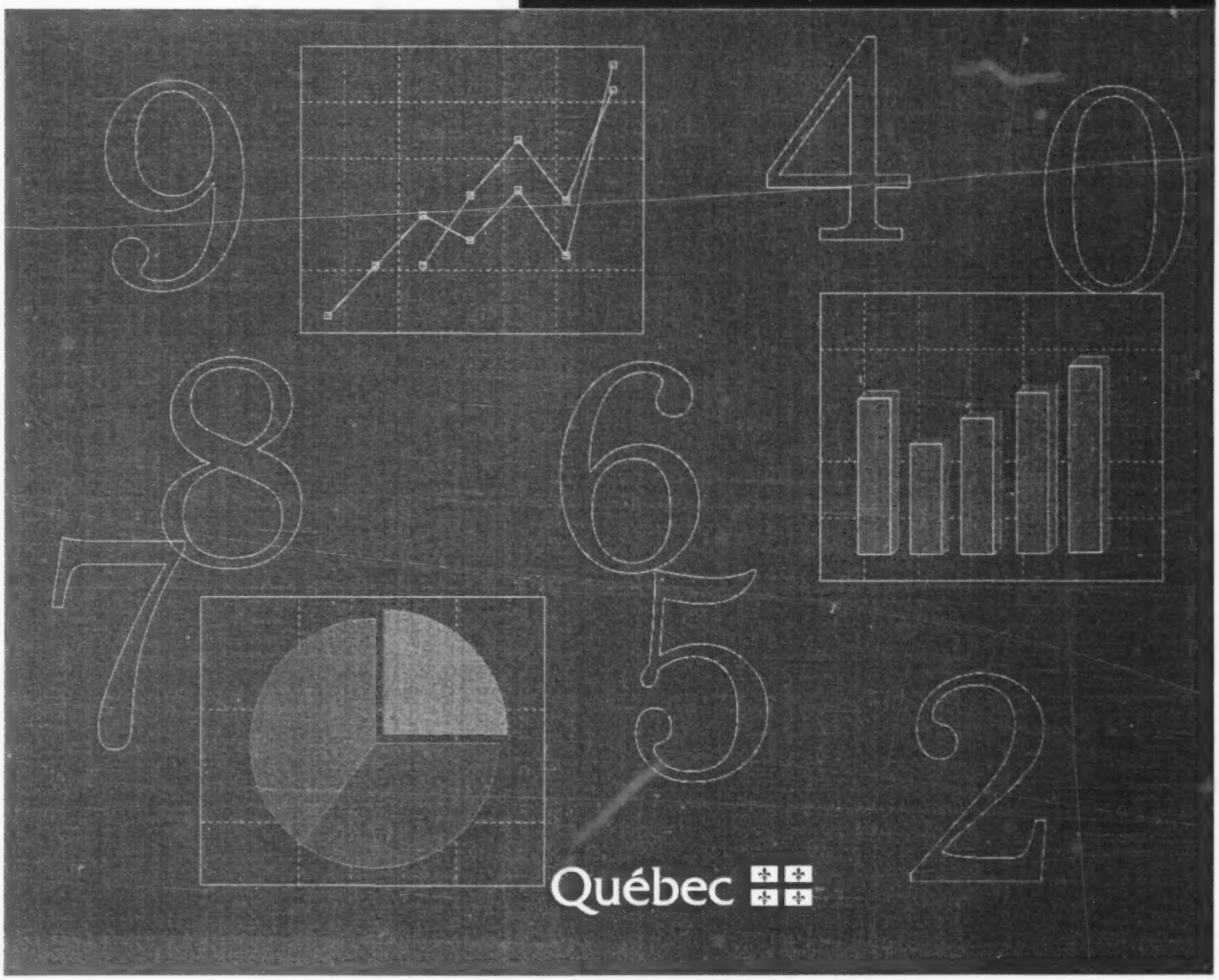
LONGITUDINAL STUDY OF CHILD DEVELOPMENT IN QUÉBEC (ÉLDEQ 1998-2002)

5-MONTH-OLD INFANTS

Sleep

COLLECTION
Health and Well-Being

Volume 1, Number 4



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May 2000

Forward

Similar to what has been observed in the majority of industrialized nations over the past twenty years, Québec and Canada have seen a significant increase in the costs related to maladjustment, particularly in young people. The Longitudinal Study of Child Development in Québec (*l'Étude longitudinale du développement des enfants du Québec*) (ÉLDEQ 1998-2002) being conducted by *Santé Québec* (Health Québec),[1] a division of *l'Institut de la statistique du Québec (ISQ)*[2] (Québec Institute of Statistics) in collaboration with a group of university researchers, will provide an indispensable tool for action and prevention on the part of government, professionals and practitioners in the field, who every day must face maladjustment in children.

More precisely, a major purpose of this longitudinal study of a cohort of newborns is to give Québec a means of preventing extremely costly human and social problems, such as school dropout, delinquency, suicide, drug addiction, domestic violence, etc. Similar to what is being done elsewhere (in the UK, New Zealand, the US), *Santé Québec* and a group of researchers have designed and developed a longitudinal study of children 0 to 5 years of age (2,223 children in this study and 600 twins in a related one). It will help gain a better understanding of the factors influencing child development and psychosocial adjustment.

The general goal of ÉLDEQ 1998-2002 is to learn the PRECURSORS, PATHS and EFFECTS, over the medium and long terms, of children's adjustment to school. ÉLDEQ is the logical extension of the National Longitudinal Study of Children and Youth (NLSCY, Canada). These Québec and Canada-wide longitudinal studies are both comparable and complementary. They employ distinct survey methods, and use different techniques to obtain the initial samples. Though many of the instruments are practically identical, about a third of those being used in ÉLDEQ are not the same.

This first report casts light on the enormous potential of the data generated by this study. From the descriptive analyses of the results of the first year of the study to the longitudinal analyses of subsequent years, there will be an enormous wealth of data. With updated knowledge on the development of the cohort of young children, the annual longitudinal follow-up will respond to the needs which the *ministère de la Santé et des Services Sociaux du Québec - MSSS* (Ministry of Health and Social Services), who financed the data collection, expressed in both the Report of the Working Group on Youth (*Rapport Bouchard, 1991, Un Québec fou de ses enfants* - the Bouchard Report, 1991, A Québec in Love with its Children) and the policy papers entitled *Politique de la santé et du bien-être, 1992* (Health and Well-Being) and *les Priorités nationales de santé publique 1997-2002* (Public Health Priorities 1997-2002).

Director General

Yvon Fortin

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1. Certain French appellations in italics in the text do not have official English translations. The first time one of these appears, the unofficial English translation is shown immediately after it. Following this, for ease in reading, only the official French name appears in the text in italics, and it is suggested the reader refer to the Glossary for the English translation.

2. *Santé Québec* officially became a division of the *ISQ* on April 1, 1999.

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Caution:

Unless indicated otherwise, "n" in the tables represents data weighted to the size of the initial sample.

Because the data were rounded off, totals do not necessarily correspond to the sum of the parts.

Unless explicitly stated otherwise, all the differences presented in this report are statistically significant to a confidence level of 95%.

To facilitate readability, proportions higher than 5% were rounded off to the nearest whole unit in the text, and to the nearest decimal in the tables and figures.

Weighting and the complex sample design were taken into account in calculating the results and their precision. The precision of the estimates of proportions was calculated using a mean design effect. This was also used for the chi-square tests, except in questionable cases for which the SUDAAN software program was used. In all other analyses, SUDAAN was used. Basic hypotheses, such as the normality of the data, were verified before applying the selected statistical tests.

Symbols

... Not applicable (N/A)
.. Data not available
-- Nil or zero
p < Refers to the threshold of significance

Abbreviations

CV	Coefficient of variation
Not avail.	Not available
not signif.	Not significant

Acknowledgments

Santé Québec recognizes that the development and implementation of the Longitudinal Study of Child Development in Québec (ÉLDEQ 1998-2002) flows directly from the synergy of effort and professionalism of many people throughout the whole process of mounting a survey of this size. Since 1995, individuals, various groups and organizations, a survey firm and the staff of *Santé Québec* have become indispensable links in making this ambitious project a reality - the first annual longitudinal survey of Québec infants.

A major characteristic of this project is that a pretest and survey are conducted every year. To accomplish this, we must annually: 1) make two sets of instruments (pretest and survey), 2) conduct two data collections, 3) analyze two sets of data, and 4) produce two types of communications materials. The results of each pretest means fine-tuning and developing instruments for the survey, which follows 17 months later. The results are sent to the parents (highlights), published in reports, and communicated to the scientific community and the public at large. The professionals and staff involved in collecting the data, as well as those involved before and after, must put their nose to the grindstone every year. We cannot over-emphasize our profound recognition of the incredible, concerted effort they are putting into this project over an 8-YEAR period, from the first pretest in 1996 to the final report to be published in 2004!

First, it must be said that without Daniel Tremblay, Director of *Santé Québec* (now part of the ISQ) since 1994, Christine Colin, Assistant Deputy Minister responsible for Public Health 1993-1998, Aline Émond, Director of *Santé Québec* 1986-1993, Richard E. Tremblay, Director of the ÉLDEQ research project, and Marc Renaud, President of *le Conseil québécois de la recherche sociale - CQRS* 1991-1997. ÉLDEQ 1998-2002, also known as "In 2002.. I'll Be 5 Years Old!," would have never seen the light of day. In turn and together, they developed, defended and obtained the financing for this study. Thank you for your indefatigable tenacity.

A warm thanks to all the researchers and the support staff of their respective research groups, whose determination over the years has never wavered. Putting their research grants together every year has contributed to the development of the instruments, analysis of the data and publication of the copious results.

I would like to thank Lyne Des Groseilliers, ÉLDEQ's statistician since 1996, Robert Courtemanche, statistical advisor, and France Lapointe, ÉLDEQ's statistician 1995-1996. These three colleagues in the *Direction de la méthodologie et des enquêtes spéciales* (Methodology and Special Surveys Division) (*ISQ*) managed, with great skill, to set the signposts and navigate the somewhat winding course of this large-scale survey first.

A very special thanks to all the master designers of the National Longitudinal Study of Children and Youth (NLSCY, Canada). Without their expertise, advice and generosity, our survey would never have been accomplished. In many senses of the word "modeling," ÉLDEQ has learnt a lot from the NLSCY.

We would also like to extend out gratitude to the staff of the *Groupe de recherche sur l'inadaptation psychosociale chez l'enfant - GRIP* (Research Unit on Children's Pyschosocial Maladjustment) at the University of Montréal. Without their expertise, some of our survey instruments would have never been computerized to such a high level of quality.

We would like to thank the personnel in the *Service de support aux opérations de la Régie de l'assurance-maladie du Québec - RAMQ* (Operations Support Section of the Québec Health Insurance Board). Without their efficiency, fewer letters of introduction would have found their way to the correct addresses of respondents.

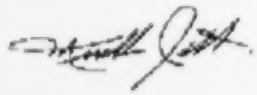
Our sincerest thanks go to our survey firm, *Bureau d'interviewers professionnels (BIP)*. Since 1996, this polling company has been responsible for data collection in the pretests and surveys, and follow-up of families both inside and outside of Québec. Lucie Leclerc, President of *BIP*, has set the standard of quality for our numerous and complex data collections. Assisted by Véronique Dorison, she has instilled in her interviewers a great sense of respect for the respondent families, as well as a rigourous regard for all the norms governing this first-of-a-kind survey in Québec.
A big thank-you to the directors-general, directors of professional services, and staff of the medical records departments of some

80 hospitals in the province who accepted to collaborate in our study at a time when resources were rare and time was at a premium, and when the medical records departments in many hospitals were merging or in the process of doing so. Their support was exceptional. Birthing centres also graciously accepted to participate in this first Québec longitudinal study of children. A special thanks to Julie Martineau, medical records specialist, who contributed to the analysis of indispensable medical information by ensuring very rigourous coding of the data, which often lay concealed in the medical files of the infants and their mothers.

It goes without saying that the staff of *Santé Québec* Division directly attached to ÉLDEQ 1998-2002 are the cornerstone of its success from practically every point of view. Special thanks for their ongoing contribution and constant hard work go to Hélène Desrosiers and Josette Thibault, responsible respectively for analysis of the data and creation of the measurement instruments; Martin Boivin, Rolland Gaudet and Gérald Benoît, who constantly pushed the limits of what computer software can do in terms of programming and data processing; Suzanne Bernier-Messier and Diane Lord, who give meaning to the word versatility, who must organize, code and manage incredible quantities of data to ensure the progress of the study. Not directly attached to the team but who made extremely important contributions are: France Lacoursière, France Lozeau and Thérèse Cloutier, who put the finishing touches to the *Santé Québec* "look" in the survey instruments, reports and conference publications; Lise Ménard-Godin, who conducted fruitful literature searches and advised on many aspects of the collection instruments. The hard work, constant availability, ability to adapt, and finely-honed skills of the people working on this project match the enthusiasm that all our partners have demonstrated in making this study a resounding success.

Finally, I would like to extend a very special thank-you to the 2,223 families who responded to our survey. Thank you for the trust you have shown in *Santé Québec*, our partners and collaborators.

Thanks to your participation, your children have become the veritable stars of ÉLDEQ 1998-2002, and are making it possible, in the short term, to gain a better understanding of psychosocial adjustment in children. In the medium and long terms, they will likely be in large part responsible for the establishment of early detection programs, better designed prevention programs, and more effective interventions for such an important clientele - all of Québec's children.



Mireille Jetté
Project Coordinator
Santé Québec Division, ISQ

Preventing Social Maladjustment

It suffices to consider the costs engendered by behavioural problems in children - school dropout, delinquency, alcoholism, drug addiction, family violence, mental disorders and suicide - to conclude that they largely surpass what a modern society can accept, morally and economically. Faced with the enormity of these problems, the first reflex is to provide services to these people which will, ideally, make the problems disappear, or at the very least, lessen their severity. For many years we have tried to offer quality services to children and adults who suffer from antisocial disorders, alcoholism, drug addiction, depression, and physical or sexual abuse. However, in spite of enormous investment, these curative services are far from being able to respond to the demand.

Although the idea of early intervention as a preventive measure can be traced at least as far back as ancient Greece, the second half of the 20th century will certainly be recognized as the dawn of the field of social maladjustment prevention (Coie *et al.*, 1993; Mrazek & Haggerty, 1994). Numerous programs have been developed for adolescents and teenagers to prevent school dropout, delinquency, drug addiction and suicide. Scientific evaluations of these programs have been far too few in number, but they tend to demonstrate that it is extremely difficult to help those most at risk in this age group (Rosenbaum & Hanson, 1998; Rutter, Giller & Hagell, 1998; Tremblay & Craig, 1995). It is becoming increasingly clear that the factors which lead to serious adaptation problems are in place long before adolescence. Hence the idea that the prevention of social adaptation problems should start at least during childhood, and preferably right from pregnancy (Olds *et al.*, 1998; Tremblay, LeMarquand & Vitaro, 1999). These principles are clearly outlined in the objectives of the *Politique de la santé et du bien-être* (Policy on Health and Well-Being) and *les Priorités nationales de santé publique* (Priorities for Public Health) set by the government of Québec (ministère de la Santé et des Services sociaux, 1992, 1997).

The Need to Understand Early Childhood Development

If the field of maladjustment prevention appeared at the end of the 20th century, it has certainly come on the heels of child development. "*Émile,*" by Jean-Jacques Rousseau, needs to be re-read in light of recent studies to realize just to what degree it is impossible to understand the complexity of child development, and therefore the means of preventing deviant paths, simply by reflection or introspection. Although considerable knowledge has been acquired in the neurological, motor, cognitive, affective and social development of children, what really hits home is that Jean-Jacques Rousseau and his followers in education seemed to have had more certainty about the ways of educating children than we do today.

Progress in child development research has made us realize that things are not as simple as we can or would like to imagine. We have obviously all been children, and most of us have become parents, indeed, relatively well-adjusted ones. But we still do not clearly understand when, how and why adjustment problems appear, and above all, how to prevent and correct them.

Our ignorance is obvious when we examine the debates among specialists on the role of parents in the development of maladjustment problems in children. Some suggest that social maladjustment in children is largely determined by genetic factors (Bock & Goode, 1996; Rowe, 1994). Some accentuate economic factors (Duncan & Brooks-Gunn, 1997). Other researchers attribute a determining role to peer influence (Harris, 1998; Harris, 1995; Vitaro *et al.*, 1997). These larger questions lead to narrower ones which focus on particular aspects - the role of fathers in childhood maladjustment, the impact of alcohol and cigarette consumption during pregnancy, the effect of prenatal and birthing problems, the importance of breast feeding and diet; the role of sleep, cognitive development, temperament, and so on.

The majority of these questions are at the heart of the daily concerns of parents, grandparents, educators, family service providers, and legislators. What can we do to maximize the development of our children, to prevent severe psychosocial maladjustment? What should we do when problems begin to appear, when pregnant mothers, or fathers themselves have

a long history of disorders? The answers to these questions obviously have an effect on the policies put forth by Québec government Ministries such as *ministères de la Famille et de l'Enfance* (Family and Child Welfare), *de l'Éducation* (Education), *de la Santé et des Services sociaux, de la Solidarité sociale* (Social Solidarity - formerly Income Security (Welfare)), *de la Sécurité publique* (Public Security), *de la Justice* (Justice), and *le ministère de la Recherche, Science et Technologie* (Research, Science and Technology).

The Contribution of ÉLDEQ 1998-2002

The Longitudinal Study of Child Development in Québec (ÉLDEQ 1998-2002) was conceived in order to contribute to our knowledge of the development of children in their first 5 years of life. The main goal is to gain a better understanding of the factors, in the years of rapid growth, which lead to success or failure upon entry into the school system. The goal of the second phase (if approved) is to better understand development in elementary school, in light of development in early childhood.

We know that this survey cannot be a definitive one on child development in Québec, but it is the first representative study of a provincial cohort of children who will be measured annually from birth to entry into the school system. It specifically aims at understanding the development of basic skills needed for educational success.

Although the effort to set up this study began in 1989, the first data collection coincided with the Québec government's implementation of its *Politique Familiale* (Policy on Families). The policy has virtually the same objectives as our study:

> "These services for children 5 years and under should give all Québec children, whatever the socioeconomic status of their parents, the chance to acquire and develop the skills that will allow them to succeed in school (1997, p. 10)."

On March 3 1999, in the speech opening the 36th session of the Québec legislature, Premier Lucien Bouchard confirmed that early childhood development was a priority for the government:

> "The theme that will dominate our actions this year, next year, and throughout our mandate, is youth... The priority.. with regards to youth in Québec, begins with the family and childhood... This massive investment in early childhood... will give our children the best chance of success in the short, medium and long terms. It is our best asset against alienation and despair. It is our best preparation for personal, social and economic success."

Because of this historic coincidence, ÉLDEQ has the potential of becoming an invaluable tool for monitoring the effects of Québec's massive investment in early childhood which began in 1997. Thanks to the data collected by the federal government's National Longitudinal Study of Children and Youth (NLSCY, Canada), we will be able to compare child development in Québec with that elsewhere in Canada, before and after the implementation of Québec's new policy on the family.

However, our initial objectives are more modest. The 12 or 13 papers in this series present the results of our first annual data collection. They describe the characteristics of the families and children when the latter were 5 months old.[3] They cover sociodemographic characteristics, nature of the birthing process, health and social adaptation of the parents, family and couple relations, parent-infant relations, and characteristics of the 5-month-old, such as sleep, diet, oral hygiene, temperament, and motor, cognitive and social development. These data will eventually be compared to those on children the same age collected by the NLSCY in 1994 and 1996.

An Interdisciplinary, Multi-University Team of Researchers

This study saw the light of day because of the collaboration of many people. In the preceding pages, Mireille Jetté thanked a number of them. I would like to take advantage of this introduction to emphasize that the survey was set up and continues forward because of the dedication and hard work of a group of researchers from a variety of disciplines and universities. I would particularly like to thank Michel Boivin, School of Psychology at Laval University, and Mark Zoccolillo, Department of Psychiatry at McGill University,

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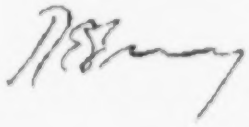
3. To simplify the text in this report, the phrase "5-month-old infants" will be used to refer to infants whose mean age was 5 months during data collection in 1998. In section 3.1.3 (Volume 1, Number 1), we explain why the infants were not all exactly the same age. As indicated in no. 2 of this series, 52% of the infants were less than 5 months, and 3.4% were 6 months of age or over.

who have been actively involved in this project since 1992. It was in that year that we prepared out first grant application for the Social Sciences and Humanities Research Council of Canada. A second group of researchers joined the team in 1993 and 1994: Ronald G. Barr, pediatrician, Montréal Children's Hospital Research Institute, McGill University; Lise Dubois, dietitian and sociologist, Laval University; Nicole Marcil-Gratton, demographer, University of Montréal and Daniel Pérusse, anthropologist, University of Montréal. Jacques Montplaisir, Department of Psychiatry, University of Montréal, joined the team in 1995. Louise Séguin, Department of Social and Preventive Medicine, University of Montréal and Ginette Veilleux, *Direction de la santé publique de la Régie régionale de la santé et des services sociaux de Montréal-Centre* (Public Health Department, Montréal-Centre Regional Health Board), joined in 1998. Three post-doctoral researchers have also made an important contribution. Raymond Baillargeon developed the task for measuring cognitive development. Christa Japel is the assistant to the scientific director for planning, analysis and presentation of the results. Heather Juby collaborates in the analysis of the data on couple and family history.

A Unique Confluence of Circumstances

A study such as this requires the coordination of many researchers over many years, enormous financial resources, and a long period of preparation. Though in the early 1990s the research team was convinced of the need for the survey, those responsible for the public purse had also to be convinced. We must therefore acknowledge the happy confluence of circumstances that allowed the players to take advantage of the opportunity at hand. When a number of civil servants in the *ministère de la Santé et des Services sociaux* understood the essential role of prevention, the creation of a committee on children and youth in 1991 led to an increased awareness of the importance of early childhood. At the same time, the president of the *CQRS*, Marc Renaud, had come to the same realization with his colleagues in the Population Health Program at the Canadian Institute for Advanced Research (CIAR). Aline Émond, the Director of *Santé Québec*, was ready to apply her formidable determination to work for the cause. For their part, Health Minister Jean Rochon and his Assistant Deputy Minister for Public Health, Christine Colin, aware of the importance and benefit of longitudinal studies on early childhood development, authorized the investment of large sums of money during a period of draconian budget cuts. This occurred at the same time as the federal government decided to create its own longitudinal study of children and youth (NLSCY). It is in this context that ÉLDEQ 1998-2002 materialized. Our survey also came to fruition because Mireille Jetté did everything in her power to make the researchers' dreams a reality, and Daniel Tremblay gave her all the support she needed by making various resources available for the project.



Richard E. Tremblay, Ph.D., M.S.R.C.
Chair of Child Development
University of Montréal

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Review of the Methodology

This analytical paper is one of a series presenting cross-sectional data collected on a large sample of 5-month-old infants surveyed in 1998. It reports on the first of 5 annual data collections on 2,120 children in Québec who will be studied until they are 5 years old. In the first year of data collection, the results on 2,223 infants were retained.[4]

The target population of the survey is Québec babies, singleton births only,[5] who were 59 or 60 weeks of gestational age[6] at the beginning of each data collection period, born to mothers residing in Québec, excluding those living in the Northern Québec, Cree, and Inuit regions, and on Indian reserves, and those for whom the duration of pregnancy was unknown. Due to variations in the duration of pregnancy and the 4 or 5 weeks allotted for each data collection wave, the infants were not all exactly the same age (gestational or chronological) at the time of the survey. Therefore, the children in Year 1 (1998) of the survey had a mean gestational age of 61 weeks - about 5 chronological months.

The survey had a stratified, three-stage sampling design, with a mean design effect for the proportions estimated at 1.3. To infer the sample data to the target population, each respondent was given a weight corresponding to the number of people he/she "represented" in the population. ÉLDEQ 1998 comprised eight main collection instruments which obtained data from the person who was closest to the baby (called the Person Most Knowledgeable - PMK), the spouse (married or common-law), the infant and the absent biological parent, if applicable. Given variation in the response rates to each instrument, three series of weights had to be calculated to ensure inferences to the population were accurate. Except for the Self-Administered Questionnaire for the Absent Father (SAQFABS) and a series of questions in the Computerized Questionnaire Completed by the Interviewer (CQCI) on absent fathers - the overall or partial response rates of which were too high - the results of all the instruments could be weighted. Therefore, the data presented here have all weighted to reduce the biases.

All data that had coefficients of variation (CV) higher than 15% are shown with one or two asterisks to clearly indicate the variability of the estimate concerned. In addition, if the partial non-response rate was higher then 5%, there is a note specifying for which sub-group of the population the estimate is less accurate.

Similar to any cross-sectional population study, the Year 1 part (5-month-old infants) of ÉLDEQ 1998-2002 has certain limits. However, the vast majority of the results are valid and accurate, and provide a particularly detailed portrait, for the first time, of 5-month-old infants in Québec.

Note to the reader: For more details on the methods, see Volume 1, Number 1 in the present series. Detailed information on the sources and justification of the instruments used in Year 1 of ÉLDEQ 1998-2002, and the design of the scales and indices used in this paper, are covered in Number 12, entitled "Concepts, Definitions and Operational Aspects."

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4. Though the results for 2,223 children were retained for the first year of data collection, 2,120 will be retained for the rest of the longitudinal study; the extra 103 were part of an over-sample used to measure the effects of the January 1998 ice storm.

5. Twins (twins births) and other multiple births were not targeted by the survey.

6. Gestational age is defined as the sum of the duration of gestation (pregnancy) and the age of the baby.

1. Introduction

Sleep disorders in children are a major concern for parents and one of the most common problems seen in clinical pediatrics (Anders & Keener, 1985; Jenkins *et al.*, 1984). It is estimated that up to 30% of children aged 6 months to 4 years present difficulties in going to bed, falling asleep or sleeping continuously through the night (Carey, 1974; Lozoff *et al.*, 1985; Moore & Ucko, 1957). The effects of a poor sleep are many and have an impact on all aspects of child development (physical, social, cognitive), without counting the fact that from birth, the parent-child relationship can be tainted by the perception that the child has a difficult temperament. Babies who wake up often and do not easily fall back asleep may unfortunately have a higher risk of physical abuse (Bax, 1980). Moreover, sleep problems such as excessive daytime sleepiness and certain parasomnias such as night terrors, nightmares, somnambulism, and enuresis are more common in children who suffer from sleep-wake disorders in their first year of life (Salzarulo & Chevalier, 1983). For example, the tendency to awaken frequently at night can occur continually from the age 6 months until school entry (Jenkins *et al.*, 1984; Klackenberg, 1971; Moore & Ucko, 1957; Richman *et al.*, 1982). In pediatric psychiatry, persistent sleep problems are considered the first reliable signs of emotional problems and psychological distress that can appear in early childhood and affect the child's behaviour (Sperling, 1971). Studying the consolidation of the sleep-wake rhythm in infants and identifying the factors likely to impede or foster this process are therefore very important in any study of child development. Hence the purpose of this paper - to present a portrait of the sleep-wake rhythm in Québec infants approximately 5 months of age. Another goal is to determine the influence of factors proper to the infant or his family environment on the consolidation of sleep. The conclusion then suggests certain intervention paths aimed at preventing sleep problems in early childhood. However, it is essential to first have a clear understanding of the particularities of infants' sleep.

1.1 Sleep Stage Organization in Young Children

Sleep in newborns is very different from that in adults. It consists of two immature sleep states - active sleep, the precursor of REM sleep, and quiet sleep, the precursor of non-REM sleep (Aserinsky & Kleitman, 1955). Already at 3 months, infants' sleep can be divided into REM and non-REM sleep, the latter subdivided into four distinct states or stages, just as in adult sleep (Crowell *et al.*, 1982, Louis *et al.*, 1997). The association of an episode of non-REM sleep and an episode of REM sleep constitutes a sleep cycle. In the course of a night, a dozen sleep cycles have been observed in infants up to the age of approximately 9 months (Louis *et al.*, 1997), whereas only five on average have been observed in adults. After birth, the proportions of these two episodes are the same in all cycles. This progressively changes in the first few years - deeper non-REM sleep will become more predominant in the first cycles of the night, whereas the longest REM episodes will be in the cycles at the end of the night (Anders *et al.*, 1995). Moreover, active or REM sleep gradually decreases over the first two years - from 50% at birth to 40% between 3 and 5 months, then to 30% between 12 and 24 months (Niedermeyer, 1987). An excellent longitudinal study has revealed the development of the internal organization of sleep stages in children 3 months to 2 years of age (Louis *et al.*, 1997).

Concurrently with changes in the internal organization of sleep, the sleep-wake cycle progressively lengthens to approach a 24-hour rhythm. At birth, infants sleep 16 to 18 hours a day. For a short period, their sleep-wake cycles are approximately 3 to 4 hours, both day and night. At 6 months, the longest period of sleep is normally 6 hours and occurs at night. Parallel to this, the awake period in the day consolidates and lengthens. Daytime naps gradually decrease. From approximately 3 naps a day at the age of 3 months, the baby progresses to 2 naps between 6 and 15 months, then only one nap, from the age of 18 months to 3 years (Weissbluth, 1995). It is not uncommon, though to have an afternoon nap until the age of 5. The mean number of hours of daytime sleep is approximately 3.5 hours at 6 months and 2.5 hours at 18 months of age (Weissbluth, 1995). The relationship between these milestones and rather precise ages suggests that the organization of the sleep-wake rhythm depends, at least in part, on the maturation of the infant's nervous system (Anders & Keener, 1985; Coons & Guilleminault, 1982).

1.2 Establishment of the Sleep-Wake Cycle - Maturation and Favourable Conditions

The consolidation of sleep and awake occurs simultaneously with the development of other circadian (24-hour) rhythms such as body temperature, cardiovascular regulation and secretion of hormones such as cortisol, growth hormone and melatonin. Circadian rhythms are in large part controlled by a group of cells located in the centre of the brain which acts like a veritable biological clock. It seems that this group of cells is not functional until the age of a few months (Harper *et al.*, 1981). Similarly, the circadian rhythm of melatonin, the endogenous hormone that induces sleep, is not discernible until the 45th day of life (McGraw *et al.*, 1999). However, external synchronizers (light/dark cycle, noise, social stimulation) may act earlier on the sleep-wake rhythm (Harper *et al.*, 1981). In this regard, it has been demonstrated that newborns may already have a certain sleep-wake rhythm the first day after birth, meaning their longest wake period is during the day and longest sleep period during the night (Freudigman & Thoman, 1994).

Variability in the age of consolidating the sleep-wake rhythm suggests that factors other than the maturation of the nervous system may influence this process. A study conducted on 1,691 five-month old infants born prematurely and 2,712 ones born at term suggested that the immaturity of the nervous system plays a less important role than poor parenting skills in the development of sleep disorders (Wolke *et al.*, 1995). Anders and Eiben (1997) go as far as to suggest that parent-child interactions at bedtime can predict "protodyssomnias" (precursors of insomnia).

In addition to the maturation of the nervous system and parenting behaviours related to sleep, physical aspects of the sleep environment, certain biological characteristics proper to the child, standard of living and other family characteristics are also likely to influence sleep, and therefore merit closer attention.

With regards to the sleep environment, it has been demonstrated, for example, that above or below the zone of thermoneutrality, the amount of sleep decreases (Glotzbach & Heller, 1994) and the number of awakenings increases (Wailoo *et al.*, 1989). Similarly, it is of prime importance to give the infant distinct phases of light (day) and darkness (night) to establish a normal sleep-wake cycle. The cellular activity of the biological clock is modulated by light entering the eyes. In contrast, the secretion of melatonin, the sleep hormone, is inhibited by light. It has been reported that constant illumination, day and night, impedes the development of the sleep-wake cycle, leading to persistent sleep problems (Mann *et al.*, 1986). The first few months of life constitute a critical period for learning the rhythm. Without this conditioning, the sleep-wake cycle may never establish itself in a normal manner (Ma *et al.*, 1993).

Furthermore, pediatricians recommend that babies and children in general sleep alone. Sleeping in the parents' bed is not only associated with a higher prevalence of sleep disorders, particularly in children over 4 years of age (Ottaviano *et al.*, 1996), but also with a higher number nocturnal awakenings in babies (Lozoff *et al.*, 1996). For example, Lozoff *et al.* (1984) observed that of children 6 to 48 months of age who slept in their parents' bed, 65% had a disturbed sleep versus 28% who slept alone. However, cosleeping is a practice that varies with factors such as ethnicity (sleep habits) and socioeconomic status (Lozoff *et al.*, 1996).

Wolf and Lozoff (1989) reported that the use of transitional objects is more frequent in children who fall asleep or fall back asleep alone than in children who need to be put to sleep or put back to sleep when they awaken at night. A term developed by Winnicott (1953), a transitional object is an inanimate object such as a blanket, teddy bear, or pacifier that the baby uses to feel secure in the absence of the mother during periods of stress or at bedtime. Indeed, separation anxiety can cause frequent nocturnal awakenings (Ferber, 1995). Transitional objects normally have their greatest importance between the ages of 9 months and 3 years, but may play a role earlier (Ferber, 1995).

Certain characteristics proper to the child may also influence the age at which sleep is consolidated. Birth complications, such as a birth weight below 2.5 kg., have been shown to be associated with night waking in babies 1 to 3 years of age (Minde *et al.*, 1993). Birth order may also be a factor. Firstborns, for example, have more difficulty than other children in sleeping through the night (Benoit *et al.*, 1992). Difficult temperament has also been associated with sleep disturbances (Minde *et al.*, 1993). Health status, as well, has been associated with night waking (Anders *et al.*, 1992; Bernal, 1973; Blurton-Jones *et al.*, 1978). Premature birth and sex of the infant, however, seem to have little influence on consolidation of the sleep-wake cycle (Anders & Keener, 1985).

Family characteristics and standard of living can also delay or promote the consolidation of sleep when they are associated with certain habits or practices of putting the infant to bed. For example, socioeconomic status, family structure (intact, single-parent or step), depression status or ethnocultural background can be related to this process. Feeding methods, age of solid food introduction, and certain lifestyle habits of the parents may also influence the consolidation of the sleep-wake rhythm in infants. These are therefore examined in the analysis that follows.

2. Methodological Aspects

2.1 Target Population

Characteristics of the target population are described in Numbers 1 and 2 in this series. However, it is important to reiterate caution with regards to the infants' age. Similar to many other aspects of child development, sleep is in part determined by the maturity of the nervous system and, as discussed earlier, by parenting practices and conditioning. Therefore it is important to keep as a constant either the maturation of the child's physiology by targeting a precise gestational age[7] independent of chronological age, or the child's experience of the external world by targeting a precise chronological age, whatever the gestational age. ÉLDEQ initially targeted infants with a gestational age of 59 to 63 weeks. However, given the time span of the data collection waves, a small percentage of the babies were as young as 56 weeks and as old as 65 weeks of gestational age (2%). The chronological age of the infants ranged between 3.5 and 8.3 months, the vast majority (97%) being between 4 and 5 months. To facilitate reading, the population will be presented in this paper as having a mean chronological age of 5 months, which was the target age of ÉLDEQ 1998.

2.2 Survey instruments

The sleep data (habits, environment, related parental behaviours) on the infants were taken from the Self-Administered Questionnaire for the Mother (SAQM). This instrument, described in Number 1 in this series of papers, was specifically designed for ÉLDEQ. The section on the infant's sleep has no equivalent in similar studies such as the National Longitudinal Study of Children and Youth (NLSCY, Canada), which has only a few general questions on sleep.

Variables related to the infants' sleep were not measured in an objective manner in a sleep lab, but were based on the opinions or perceptions of the mothers. This was the case for the main question "Does your baby sleep undisturbed (straight) through the night?," which provided a snapshot of the sleep-wake rhythm of the infant.

Various data derived from other instruments used in Year 1 (1998) of ÉLDEQ were tested for associations with whether the infants were sleeping through the night. First were characteristics known to be associated with child development such as sex, chronological age, premature status, birth order, birth weight and general health status, derived mainly from the Computerized Questionnaire Completed by the Interviewer (CQCI), and temperament, derived from the Self-Administered Questionnaire(s) for the Mother and Father (SAQM, SAQF). With regards to feeding method, this was derived from the responses to the Paper Questionnaire Completed by the Interviewer (PQCI).

Other variables retained reflected family characteristics and standard of living of the infant's household, namely socioeconomic status of the family,[8] type of family and characteristics of the mother (e.g. immigrant status, education, overprotectiveness, depression).[9]

2.3 Statistical Analyses

Three types of analyses were conducted on the weighted data:

1) Frequency analyses to provide a portrait of sleep and the sleep environment.
2) Univariate analyses to compare infants who were sleeping through the night with those not doing so, related to previously

7. Gestational age is the sum of the duration of gestation and the age of the child.

8. Socioeconomic status of the family, represented here as a continuous index, was derived from the following variables - education (number of years) of the parent(s), occupational prestige of the mother and spouse/partner, if applicable, and household income. For more details on this variable, see Numbers 2 and 12 in this series of analytical papers.

9. Although certain individual characteristics of the father or mother's spouse/partner such as age or depression status were also likely to be associated with consolidation of the sleep-wake rhythm, it was decided not to examine these in this paper since to do so would have meant limiting the analyses to two-parent families for which information was available. It should be noted again that the questions on sleep were part of the questionnaire for the infant's mother.

described characteristics such as sleep environment, parental behaviours, infant and family characteristics.[10]

3) Multivariate analysis using logistical regression to identify the most determinant variables of sleep consolidation.

Since in the majority of cases the variables were tested simultaneously, those retained should be regarded as either being associated or not associated with sleep consolidation, not determinants of this behaviour.

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10. Chi-square tests were conducted on nominal and dichotomous variables, and t tests on continuous ones.

3. Results

3.1 Sleep-Wake Organization in Québec Infants

The sleep-wake profile of 5-month-old Québec infants in 1998 is presented in Table 3.1. As indicated, the majority (62%) were taking less than 15 minutes to fall asleep. For 7 out of 10 infants, night was interrupted by 2 awakenings or less. Approximately 1 in 5 (21%) did not wake up at night. Most infants (77%) were capable of sleeping 6 straight hours a night; slightly more than half (51%) were sleeping at least 8 straight hours. Sleeping at least 6 hours in a row indicates consolidation of the circadian sleep-wake rhythm, namely the longest period of sleep occurring at night and the longest period awake occurring during the day.

At what age did this rhythm appear in Québec infants?

Table 3.1
Sleep Characteristics of Infants (%) by Whether They Were Sleeping Through the Night at the Age of 5 Months, 1998

	Sleeping through the night	Not sleeping through the night	Total		χ^2
			n	%	
Time to fall asleep					
Less than 15 min	64.4	54.6	1,309	62.2	$p < 0.001$
From 15 to less than 30 min	30.9	35.9	672	32.0	
30 min or more	4.7	9.5*	122	5.8	
Frequency of difficulty in falling asleep					
Never	26.2	20.1	520	24.9	$p < 0.001$
Sometimes	65.6	56.8	1,334	63.8	
Often	5.9	15.3	166	7.9	
Always	2.3*	7.8*	72	3.4	
Number of consecutive hours a night					
Less than 6 hours	8.7	74.7	481	22.9	$p < 0.001$
From 6 to less than 8 hours	27.8	21.3	555	26.4	
8 hours or more	63.5	4.0**	1,067	50.7	
Duration of longest nap (daytime)					
Less than 2 hours	50.8	59.9	1,110	52.8	$p < 0.01$
From 2 hours to less than 3 hours	35.4	27.1	708	33.7	
3 hours or more	13.8	13.0	286	13.6	
Number of night awakenings					
None	25.8	2.0**	433	20.7	$p < 0.001$
1-2	47.8	50.0	1,011	48.2	
3 or more	26.5	48.0	652	31.1	
Total					
n	**1,662**	**453**	**2,115**	**100.0**	--
%	**78.6**	**21.4**	--	**100.0**	

* Coefficient of variation (CV) between 15% and 25%; interpret with caution.

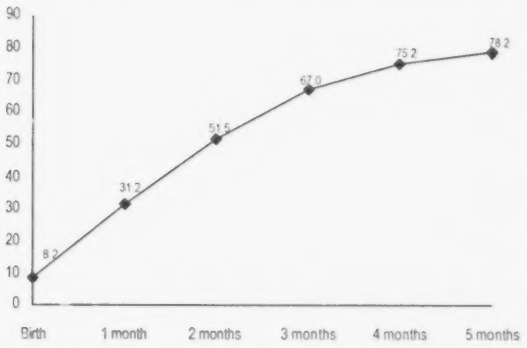
** Coefficient of variation (CV) higher than 25%; imprecise estimate for descriptive purposes only.

Source: *Institut de la statistique du Québec, ÉLDEQ 1998-2002.*

3.2 Age of Onset of Consolidated Night Sleep

The data presented in Figure 3.1 reveal that 8% of Québec babies were, as reported by their mothers, sleeping through the night right after birth, 52% at 2 months and 75% at 4 months. The percentage at the age of 5 months (78%) is undoubtedly under-estimated, since a proportion of the population had not yet attained this age by the time of the survey.

Figure 3.1
Cumulative Percentage of Infants who Were Sleeping Through the Night, by Age, 1998

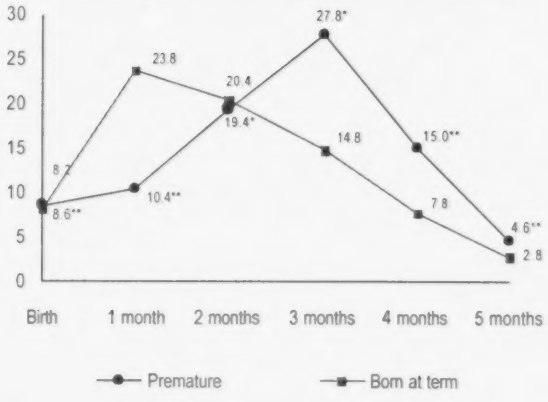


Source: *Institut de la statistique du Québec, ÉLDEQ 1998-2002.*

It is interesting to note that prematurely born infants, namely those whose gestation period was less than 37 weeks, showed a delay of 2 months compared to infants born at full term with regards to the chronological age at which the peak incidence of sleeping through the night appeared. Figure 3.2 shows that the peak incidence of this behaviour was about 1 month for babies born at term and 3 months for those born prematurely. However, already at 3 months, the cumulative percentage of premature babies who were sleeping through the night was similar to that of those born at term.

The sleep characteristics of babies who were sleeping through the night and those who were not, as reported by their mothers, are presented in Table 3.1. For the majority of the mothers, the concept of sleeping through the night seemed to mean at least 6 straight hours. Indeed, 75% of infants who were not sleeping through the night were sleeping less than 6 hours in a row, whereas 91% of those described as sleeping through the night by their mothers were sleeping at least 6 hours in a row. Undoubtedly, the working definition of «sleeping through the night» varies slightly from one person to the next. It is surprising, however, that 4% of mothers who reported that their infant was not sleeping through the night also reported that he/she was sleeping on average 8 straight hours or more each night (Table 3.1).

Figure 3.2
Age at Which Premature Babies and Those Born at Term Were Sleeping Through the Night, 1998



* Coefficient of variation (CV) between 15% and 25%; interpret with caution.

**Coefficient of variation (CV) higher than 25%; imprecise estimate for descriptive purposes only.

Source : *Institut de la statistique du Québec, ÉLDEQ 1998-2002.*

Compared to babies who were sleeping through the night, those who were not (21%) were taking more time to fall sleep. For example, 10% of those not sleeping through the night were taking 30 minutes or more, compared to 5% of those who were. They also had more frequent difficulty falling asleep (23% often/always vs. 8 %). They had shorter daytime naps; 60% had naps lasting less than 2 hours compared to 51% who were sleeping through the night. Moreover, they were more likely to awaken several times during the night. Nearly half (48%) were waking at least 3 times a night, whereas this was the case for only 27% of those who were sleeping through the night (as reported by their mothers). For babies sleeping through the night, this probably meant very short awake periods that required little or no effort on the part of the parents, and that the mother did not consider real interruptions in night sleep. No night waking was reported in 2% of babies not

sleeping through the night. These infants probably had a single period of continuous sleep, which may have been perceived as too short for the mother or which ended early, before dawn. It is possible that for some mothers, the concept of sleeping through the night denoted a longer period than that perceived by other mothers.

What factors were associated with the onset of a consolidated sleep-wake rhythm?

3.3 Influence of the Sleep Environment

At night, 7 out of 10 infants (70%) were sleeping in darkness and/or in a room where the temperature range d between 18 and 21 degrees Celsius (71%) (Table 3.2). These percentages were the same whether the babies were sleeping through the night or not. However, the place where the baby was sleeping was associated with the establishment of a consolidated circadian sleep-wake rhythm. More babies who were not sleeping through the night were sleeping in the parents' room than those who were sleeping through the night (28% vs. 17%). Conversely, the presence of a transitional object such as a teddy bear or special blanket for falling asleep, other than a pacifier, was significantly higher in infants who were sleeping through the night (42%) than in those who were not (31%) (Table 3.2).

Table 3.2
Sleep Environment of Infants (%) by Whether They Were Sleeping Through the Night at the Age of 5 Months, 1998

	Sleeping though the night	Not sleeping through the night	Total		χ^2
			n	%	
Darkness in the room					
Yes	70.4	68.3	1,469	70.0	Not signif.
No	29.6	31.7	630	30.0	
Temperature in the room[1]					
17°C or less	5.9	5.4	120	5.8	Not signif.
Between 18° and 21° C	71.1	70.5	1,465	71.0	
Between 22° and 25° C	22.4	23.5	466	22.6	
26°C or more	0.6**	0.6**	13	0.6**	
Place of sleep					
Sleeps alone in his room	66.7	46.7	1,315	62.4	$p < 0.001$
Sleeps in the parents' room	16.6	27.6	399	19.0	
Sleeps in the parents' bed	5.1	14.9	151	7.2	
Shares his bed with another person	11.6	10.8	241	11.4	
Transitional object					
None	26.6	36.5	601	28.7	$p < 0.001$
Pacifier	31.1	32.4	658	31.4	
Other (teddy bear, etc.) or combination	42.3	31.1	835	39.9	
Total					
n	**1,662**	**453**	**2,115**	**100.0**	--
%	**78.6**	**21.4**	--	**100.0**	

1. Partial non-response was 5.2%; possible bias.

** Coefficient of variation (CV) higher than 25%; imprecise estimate for descriptive purposes only.

Source: *Institut de la statistique du Québec, ÉLDEQ 1998-2002.*

3.4 Influence of Parental Behaviours Related to the Infants' Sleep

The data shown in Table 3.3 reveal that 5-month-old infants who were sleeping through the night were more likely to fall asleep alone in their bed than those who were not sleeping through the night, both during the day (45% vs. 26%) and at night (43% vs. 25%). More of the latter were put to bed already asleep day (61%) or night (59%) than the former (48%). If they awoke at night, babies who were sleeping through the night were 3 times more likely to be comforted in their bed than those who were not sleeping through the night (28% vs. 10%). In contrast, the latter were more likely to be fed (76%) than the former (28%). It is important to note that for 23% of infants who were sleeping through the night, parental behaviour during nocturnal awakenings was not identified, their mothers having responded that their "baby does not wake up." If these cases are excluded, significant differences remain between those who were sleeping through the night and those who were not, for the same parental behaviours, namely "comfort him/her but leave him/her in his/her bed" (36% vs. 10%) and "feed him/her" (37% vs. 76%) ($p < 0.001$; data not shown).

Table 3.3
Certain Parental Behaviours (%) Regarding Sleep by Whether the Infants Were Sleeping Through the Night at the Age of 5 Months, 1998

	Sleeping through the night	Not sleeping through the night	Total		X^2
			n	%	
Putting infant to bed for daytime naps[1]					
Already asleep	46.5	60.9	1,024	49.6	$p < 0.001$
Awake - mother stays with infant	8.6	13.4	199	9.6	
Falls asleep alone	44.9	25.7	841	40.7	
Putting infant to bed at night[2]					
Already asleep	49.1	59.2	1,022	51.3	$p < 0.001$
Awake - mother stays with infant	8.1	16.2	197	9.9	
Falls asleep alone	42.8	24.6	774	38.8	
Night awakenings					
Lets infant cry	2.0*	1.4**	40	1.9*	$p < 0.001$
Comforts infant in his bed	27.7	9.5*	499	23.8	
Picks up and/or rocks infant	10.3	7.8*	205	9.8	
Feeds him	28.3	76.1	809	38.5	
Mother brings him to bed with her	2.4*	3.2**	55	2.6	
Other parental behaviours	6.3	2.0**	113	5.4	
Infant does not wake up	23.0	--	378	18.0	
Total					
n	**1,662**	**453**	**2,115**	**100.0**	**--**
%	**78.6**	**21.4**	**--**	**100.0**	

1. Partial non-response was 5.2%, possible bias.
2. Partial non-response was 10.3%, possible bias.

* Coefficient of variation (CV) between 15% and 25%; interpret with caution.

**C oefficient of variation (CV) higher than 25%; imprecise estimate for descriptive purposes only.

Source: *Institut de la statistique du Québec, ÉLDEQ 1998-2002.*

3.5 Influence of Infant Characteristics

More baby boys than girls were not sleeping through the night (57% vs. 43%). Firstborns were more likely to be sleeping through the night than other infants (46% vs. 39%). Compared to babies who were sleeping through the night, those who were not scored higher on the difficult temperament scales as perceived by their mothers or fathers. They also tended to be reported as having a lower health status than other infants ($p < 0.06$). The following characteristics did not seem to be associated with sleeping through the night - chronological age, premature status, birth weight, current height and weight. These comparisons are presented in Table 3.4.

Table 3.4

Certain Characteristics of Infants (%) by Whether They Were Sleeping Through the Night at the Age of 5 Months, 1998

	Sleeping through the night	Not sleeping through the night	Total	X^2
		%		
Sex				
Girl	51.6	43.0	49.7	$p < 0.01$
Boy	48.4	57.0	50.3	
Birth order				
Firstborn	45.8	39.3	44.4	$p < 0.05$
Second or higher	54.2	60.7	55.6	
Prematurity (less than 37 weeks)				
Yes	6.4	3.7**	5.8	Not signif.
No	93.6	96.3	94.2	
Poids à la naissance				
< 2.5 kg	4.5	3.7**	4.3	Not signif.
> 2.5 kg	95.5	96.3	95.7	
Good health				
Always	88.9	84.8	88.0	Not signif.
Often	8.3	10.1*	8.7	
Half the time or sometimes	2.8*	5.1*	3.3	
		M		t test
Difficult temperament (mean score)				
Mother's perception	10.5	13.8	11.2	$p < 0.001$
Father's perception	11.4	14.4	12.0	$p < 0.001$
Mean chronological age (wks)	21.8	21.6	21.8	Not signif.
Current mean weight (kg)	7.33	7.29	7.32	Not signif.
Current mean height (m)	0.65	0.65	0.65	Not signif.

* Coefficient of variation (CV) between 15% and 25%; interpret with caution.

**C oefficient of variation (CV) higher than 25%; imprecise estimate for descriptive purposes only.

Source: *Institut de la statistique du Québec, ÉLDEQ 1998-2002.*

3.6 Influence of Characteristics of the Parents and Family Environment

As shown in Table 3.5, sleep consolidation in the infant did not vary with factors such as socioeconomic status and family structure (intact, step, or single-parent). The level of symptoms of depression reported by the mother and perceived spousal/partner support did not seem to be associated with sleep consolidation in the infants.

Table 3.5
Certain Characteristics of the Parents and Family Environment of the Infants by Whether They Were Sleeping Through the Night at the Age of 5 Months, 1998

	Sleeping through the night	Not sleeping through the night	Total	χ^2
	%			
Type of family				
Intact	80.6	81.1	80.7	Not signif.
Step	11.2	9.8*	10.9	
Single-parent	8.2	9.1*	8.5	
Depression status of mother[1]	10.4	12.2	10.8	Not signif.
Education of mother				
No high school diploma	18.2	13.1	17.0	$p < 0.05$
High school diploma	33.6	34.8	33.9	
Vocational/technical diploma (school or college) or college diploma	24.3	21.7	23.8	
University degree	23.9	30.4	25.3	
Immigrant status of mother				
Non-immigrant	88.1	76.1	85.5	$p < 0.001$
"European" immigrant	2.9*	5.3*	3.4	
Non-"European" immigrant	9.0	18.6	11.1	
Mother smokes				
Every day	26.5	12.2	24.2	$p < 0.001$
Occasionally	3.8	4.7*	3.9	
Not at all	69.8	79.2	71.8	
Breast feeding				
Yes	28.1	55.9	34.0	$p < 0.001$
No	71.9	44.1	66.0	
Age of introduction of cereal (wks)[2]				
0 to 15 weeks	65.1	52.0	62.4	$p < 0.001$
16 weeks or more	34.9	48.0	37.6	
		M		t test
Mean socioeconomic status	-0.07	0.01	-0.05	Not signif.
Spousal/partner support (mean score)	8.1	8.0	8.1	Not signif.
Mean age of mother (yrs)	28.1	29.4	28.8	$p < 0.05$
Parental overprotectiveness	4.7	5.4	4.9	$p < 0.001$

1. Measured by the Depression Scale of the Epidemiological Centre (CES-D Scale). Mothers having obtained a score of 13 or higher (10th percentile) were compared to other mothers (for more details, see No. 9 and No. 12 in this series).
2. Partial non-response was 12.6%, possible bias.

* Coefficient of variation (CV) between 15% and 25%; interpret with caution.

Source: *Institut de la statistique du Québec, ÉLDEQ 1998-2002.*

However, age and educational level of the mother were inversely associated with the infant sleeping through the night. Mothers of infants who were sleeping through the night tended to be younger and relatively less educated than mothers of infants who were not. For example, 18% of the former had not completed high school whereas 13% of the latter had. Immigrant status of the mother was also associated with sleep consolidation; infants not sleeping through the night were more likely to have immigrant mothers ("European" or non-"European") than other infants (24% vs. 12%). However, the infants of 49% of "European" immigrant and 73% of non-"European" immigrant mothers slept in the parents' bed or bedroom compared to 19% of the infants of non-immigrant mothers. Similarly, more immigrant mothers stayed with their child until he fell asleep, 16% "European" and 24% non-"European, compared to non-immigrant mothers (8%) (data not shown). Table 3.5 also shows that mothers of babies who were not sleeping through the night scored higher on the overprotective scale. Mothers who had their baby fall asleep in the parents' bedroom or bed also had a higher score on the overprotective scale (6.5) (part of the SAQM) than those who had their baby fall asleep in another room, either alone (4.3) or with another person (4.1) ($p < 0.001$; data not shown). An unusual finding is that a higher proportion of 5-month-old infants who were sleeping through the night had mothers who smoked daily compared to those who were not sleeping through the night (27% vs. 16%).

Feeding method was also significantly associated with the behaviour under study. Twice as many babies who were not sleeping through the night were being breast fed at 5 months compared to the other group (56% vs. 28%). Moreover, infants who were not sleeping through the night began eating solid foods such as cereal later than those who were sleeping through the night (Table 3.5). However, these two characteristics were strongly associated; mothers who were breast feeding tended to introduce cereal later in their infant's diet (see No. 5 in this series of papers).

As much as the place where the infant sleeps, feeding method may also have played a mediating role among the many characteristics retained and the sleep habits of the infants. The associations observed between age or educational level of the mother on the one hand, and whether the infant was sleeping through the night on the other, may in part be attributable to the fact that older and more educated mothers were more inclined to breast feed their baby. In this regard, a detailed analysis revealed that the mother's age and educational level, as well as the age at which solid foods were introduced into the infant's diet, were not associated with sleep consolidation when mothers who were breast feeding and those who were bottle feeding were examined separately (data not shown).

3.7 Which Factors Were the Most Determinant of Sleep Consolidation in the Infants?

As seen above, many of the variables presented here were interrelated. To better discern the clear influence they had on sleep consolidation, a logistical regression analysis was conducted. It should be noted that 291 mothers of infants who were sleeping through the night responded that their baby "does not wake up" to the question on parental behaviour with regards to nocturnal awakenings. To retain this important variable, the 291 infants were withdrawn from the overall analysis. Ten variables were included in the regression analysis (data not shown).[11] Among these, 5 correctly categorized 71% of the infants who were sleeping through the night and 76% of those not doing so.

In order of significance, these variables were the following:

1. Parental behaviour at night awakenings
2. Mother's perception of the infant's temperament
3. Sleeping or not sleeping in the parents' bed.
4. Breast feeding or bottle feeding
5. Sex of the infant

In summary, not being fed in response to night waking, having a temperament perceived by the mother as being easy, not sleeping in the parents' bed, being bottle-fed or being female were factors strongly associated with sleeping through the night.

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11. These variables were retained because they proved to be more significant in the bivariate analysis (as indicated in the previous section), and because data were available for all the infants. Variables retained were the following: sex of the infant, mother's perception of the infant's temperament, mother's smoking habits, maternal overprotective scale, breast or bottle feeding, presence of a transitional object, sleeping in the parents' bed, place where the baby slept, and parental behaviours related to putting the infant to bed and night awakenings.

Smoking habits were not determining factors when the other factors were entered in the analysis. This may explain the strong association between the mothers' smoking status and feeding method. Mothers who smoked were less inclined to breast feed their baby (see No. 5 in this series of papers), a factor which seems to hinder sleep consolidation in infants.

However, it would be erroneous to think that breast feeding in itself impedes consolidation of the infant's sleep, especially in light of its well-known virtues for healthy development. As certain studies suggest, it is less the feeding method than the feeding time that may be causing this effect (see below).

4. Discussion

The data collected from mothers suggest that nearly 80% of 5-month-old Québec infants are sleeping through the night. This percentage is similar to that which has been reported in the literature for infants 6 months of age. A large-scale British epidemiological study showed that 83% of babies this age were sleeping through the night (Moore & Ucko, 1957) and an American study 74% (Anders *et al.*, 1983). Percentages, however, can vary with the specific formulation of the question: "Does your baby sleep through the night?", "Does your baby sleeping 5 or 6 consecutive hours a night?", or "Does your baby sleep uninterrupted from midnight to 5:00 a.m. every night?".

A certain number of Québec infants are not sleeping through the night at the chronological age of 5 months (61 months gestational age). In addition to more nocturnal awakenings, they were more likely to have difficulty falling asleep, take more time to fall asleep, and not compensate by having a longer nap during the day, compared to infants who were sleeping through the night. This confirms what was reported by Ottaviano *et al.* (1996).

4.1 Sleep Environment

The survey indicates that a majority of Québec parents were providing a good sleep environment for their 5-month-old, namely appropriate room temperature, darkness at night, and transitional objects. However, one characteristic seems to have played an important role in the consolidation of sleep in the infants - the place where he slept. Sleeping in the parents' bed or bedroom was more frequent among infants who were not sleeping through the night. The presence of a transitional object, a factor linked in a bivariate analysis to the behaviour studied, seems to have been less important when the other variables were included in the analysis. This may mean it was associated with other phenomena being measured.

4.2 Parental Behaviours - A Factor of Primary Importance

The 1998 ÉLDEQ data suggest that parental behaviours regarding sleep at bedtime (day or night), particularly at night awakenings, were determining factors in the ability of the infant to sleep through the night. Putting the baby down in his own bed, not the parents', and awake, not already asleep, teaches him to fall asleep alone, and by extension, fall back asleep alone at night without signaling awakenings by crying. This association has already been observed in smaller samples. In a study of 6-month-old infants, a greater percentage of those who announced their night awakenings by crying had been put to bed already asleep compared to those who fell back asleep alone (Keener *et al.*, 1988). Anders *et al.* (1992) demonstrated that at 3 months, babies put to bed awake tended to have longer periods of total sleep. The same study reported that 8-month-old babies who had sleep problems had been regularly put to bed already asleep and had been taken out of bed when they awoke at night. Parental presence at bedtime may also delay falling asleep and contribute to reducing the duration of nocturnal sleep (Ottaviano *et al.*, 1996). However, it should be noted that in cross-sectional studies, it is difficult to infer cause-effect relationships.

The concept of signaling night awakenings is important because a study using videotape showed that infants described by their mothers as good sleepers awoke as many times as those who were not sleeping through the night, and that these awakenings were in all likelihood physiological. The good sleepers, however, were capable of falling back asleep without disturbing their parents (Minde *et al.*, 1993). The behaviour of signaling awakenings may denote a certain separation anxiety in some infants.

4.3 Infant Characteristics

Among characteristics of the infant, only sex and birth order were associated with sleeping through the night. Comparing ages at which the babies were sleeping through the night by the duration of gestation (prematurely-born or not) showed that physiological maturation also had a certain influence on the establishment of the sleep-wake rhythm. In fact, compared to babies born at term, premature ones needed 2 extra months of postpartum life to consolidate their sleep. This period was greater than the difference in the duration of gestation between the two sub-groups (4.7 weeks). However, at the age of 5 months, prematurity seemed to be no longer associated with the consolidation of sleep.

Québec 5-month-old girls seemed to be more likely than boys of the same age to have already consolidated their sleep. The few studies investigating sex of babies as a factor associated with sleeping though the night did not reveal any difference between the sexes (Benoit *et al.*, 1992; Minde *et al.*, 1993; Ottaviano *et al.*, 1996; Paret, 1983) or observed the opposite of the above (Scher *et al.*, 1995). However, these studies were based on smaller samples or covered an older and wider age-range than ÉLDEQ.

The 1998 data show that firstborns had more facility in sleeping through the night than those who had older brothers or sisters. The opposite was observed in a previous study on a smaller sample of children aged 2 to 3 years (Benoit *et al.*, 1992). This suggests that different factors may influence sleep continuity at different ages.

Contrary to studies reporting that a birth weight less than 2,500 g or a low APGAR score are associated with frequent night waking in infants (Bernal, 1973; Blurton-Jones *et al.*, 1978; Minde *et al.*, 1993; Moore & Ucko, 1957), ÉLDEQ did not reveal any link between birth weight and sleeping through the night.

The survey identified the infant's temperament (as perceived by the mother) as one of the factors having the strongest influence on the behaviour of sleeping through the night. Another study reported a significant positive correlation between sleep problems on the one hand, and certain undesirable behaviours and the score obtained on the difficult temperament scale on the other (Minde *et al.*, 1993). Again, cause and effect cannot be differentiated. Does a difficult baby have more of a tendency to signal his awakenings, or is a baby not sleeping through the night judged to be difficult? A more in-depth study incorporating other aspects of child development, such as those being examined in this longitudinal study, will undoubtedly shed light on this question.

4.4 Standard of Living and Other Family Characteristics

The fact that socioeconomic status or type of family were not in themselves associated with the organization of the sleep-wake rhythm essentially confirms what is in the literature (Minde *et al.*, 1993). The influence of immigrant status of the mother on sleep consolidation can be explained in part by the fact that sleeping in the parents' bed and staying with the child until he falls asleep is much more frequent in certain other cultures than in North American Caucasian families (Lozoff *et al.*, 1996). This is what the ÉLDEQ analyses showed. In addition to cultural habits, disadvantaged financial situations, such as a small dwelling, probably contributed to these high percentages. Moreover, more immigrant mothers favoured breast feeding than non-immigrant mothers (see No. 5 in this series).[12] Finally, parental stress related to immigration, particularly among recent immigrants, may have had an influence on the infant's sleep.

Breast feeding, in comparison to bottle feeding, has been shown to be related to the tendency of babies to awaken at night or sleep for shorter periods (Carey, 1974, Eaton-Evans & Dugdale, 1988; Elias *et al.*, 1986; Keener *et al.*, 1988; Scher *et al.*, 1995). However, the results of Keener *et al.* (1988) showed that the time at which the infant is fed may play a role in this effect rather than the feeding method itself. After the first few months, if the infant continues to be fed just before bed to help him fall asleep, and breast feeding is more likely to be used for this purpose than the bottle, his association between feeding and sleep is maintained and reinforced. Infants therefore learn that they need to be breast fed to fall back asleep. Schmitt (1985) considers that after the age of 4 months, night feeding should be considered a conditioned behaviour rather than a physiological need. Babies wake up in anticipation of their feeding. Infants at this age should therefore be put to bed awake and weaned from night feeding. This is how they learn to fall asleep and wake up alone. Hence, as suggested earlier, we should be wary of inferring that breast feeding in itself impedes the consolidation of sleep.

12. However it should be noted that the influence of the mother's immigrant status on sleep consolidation was maintained when the feeding method of the infant at the time of the survey was included. In other words, whether they breast fed or not, a higher percentage of immigrant mothers reported that their infant was not sleeping through the night at 5 months of age (data not shown).

4.5 Other considerations

The clear lack of influence of certain other variables may indicate the importance of the maturation of the nervous system compared to the sleep environment, family or individual characteristics of the infants. At 5 months, the sleep-wake rhythm is already well-established, and the time at which these variables had an influence may well have been past. It would be pertinent to study these influences at the age of 2 months, when only half of infants sleep through the night.

It can also be surmised that only problem or "resistant" cases remained. A certain percentage of these babies could have had anomalies, delays or longer periods in their biological clock regulating circadian rhythms. A recent study (Sadeh, 1997) showed that babies 6-8 months of age presenting a late peak of melatonin secretion at night had a more fragmented nocturnal sleep. Such a late peak may also explain the greater difficulty infants not sleeping through the night had in falling asleep.

Over the course of the longitudinal study, it will be possible to verify whether babies who were not sleeping through the night at 5 months will do so at 17 or 30 months of age, and whether more of them will suffer from parasomnias than those who at 5 months had already consolidated their sleep. Associations with other aspects of their development will also be studied. It has been demonstrated that the regulation of sleep is significantly associated with attention, emotional and behavioural control in children (Dahl, 1998). Similarly, it has been observed that children with psychosocial dwarfism, namely stunted growth due to extremely stressful family experiences such as physical abuse, grow more rapidly in periods of good sleep (Wolff & Money, 1973). The researchers link this effect to the secretion of the growth hormone during deep sleep. In other words, good sleep can also foster physical growth.

Conclusion

This paper has provided an overview of the sleep patterns of 5-month-old infants and identified factors that may likely hinder consolidation of the sleep-wake rhythm at this age. The data can be used by both parents and health professionals to help identify sleep problems in children at an earlier age. In addition, knowledge of the factors which can negatively affect sleep consolidation in infants can be considered a prerequisite for adopting appropriate habits and behaviours for both prevention and cure. Since it is in part influenced by factors external to the child, particularly parental behaviours and the sleep environment, infants' sleep can indeed be improved. Greater dissemination of information on the factors which foster the development of good sleep patterns is therefore strongly suggested. This could result in the inculcation of good habits right from birth, thereby preventing the vicious circle of poor sleep/inappropriate parental behaviours which can very often persist until school age.

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Glossary

Centre de la petite enfance	Child-care centre
Commission d'accès à l'information du Québec - CAI	Québec Access to Information Commission
Conseil québécois de la recherche sociale (CQRS)	Social Research Council of Québec
Direction de la méthodologie et des enquêtes spéciales, ISQ	Methodology and Special Surveys Division, ISQ
Direction de la santé publique de la Régie régionale de la santé et des services sociaux de Montréal-Centre	Public Health Department, Montréal-Centre Regional Health Board
Direction de la technologie et des opérations statistiques, ISQ	Technology and Statistical Operations Division, ISQ
Direction des normes et de l'information, ISQ	Standards and Information Division, ISQ
Direction Santé Québec, ISQ	Health Québec Division
Étude des jumeaux nouveaux-nés au Québec - ÉJNQ	Québec Study of Newborn Twins
Fichier maître des naissances	Master Birth Register
Fonds de la recherche en santé du Québec (FRSQ)	Health Research Fund of Québec
Fonds pour la formation de chercheurs et l'aide à la recherche (FCAR)	Researcher Education and Research Assistance Fund
Groupe de recherche sur l'inadaptation psychosociale chez l'enfant - GRIP	Research Unit on Children's Pyschosocial Maladjustment
Institut de la statistique du Québec, ISQ	Québec Institute of Statistics
La Politique Familiale	Policy on Families
Le Rapport Bouchard (1991) « Un Québec fou de ses enfants »	The Bouchard Report, 1991: A Québec in Love with its Children
Les Priorités nationales de santé publique	Priorities for Public Health
ministère de l'Éducation	Ministry of Education
ministère de la Famille et de l'Enfance	Ministry of Family and Child Welfare
ministère de la Justice	Ministry of Justice
ministère de la Recherche, Science et Technologie	Ministry of Research, Science and Technology
ministère de la Santé et des Services sociaux du Québec (MSSS)	Ministry of Health and Social Services of Québec
ministère de la Sécurité publique	Ministry of Public Security
ministère de la Solidarité sociale	Ministry of Social Solidarity - formerly Income Security (Welfare)
Politique de la santé et du bien-être	Policy on Health and Well-Being
Service de la recherche	Research services
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This paper is one of a series comprising Volume 1 of: JETTÉ, M., H. DESROSIERS, R. E. TREMBLAY and J. THIBAULT (2000). Longitudinal Study of Child Development in Québec (ÉLDEQ 1998-2002), Québec, Institut de la statistique du Québec, Vol. 1.

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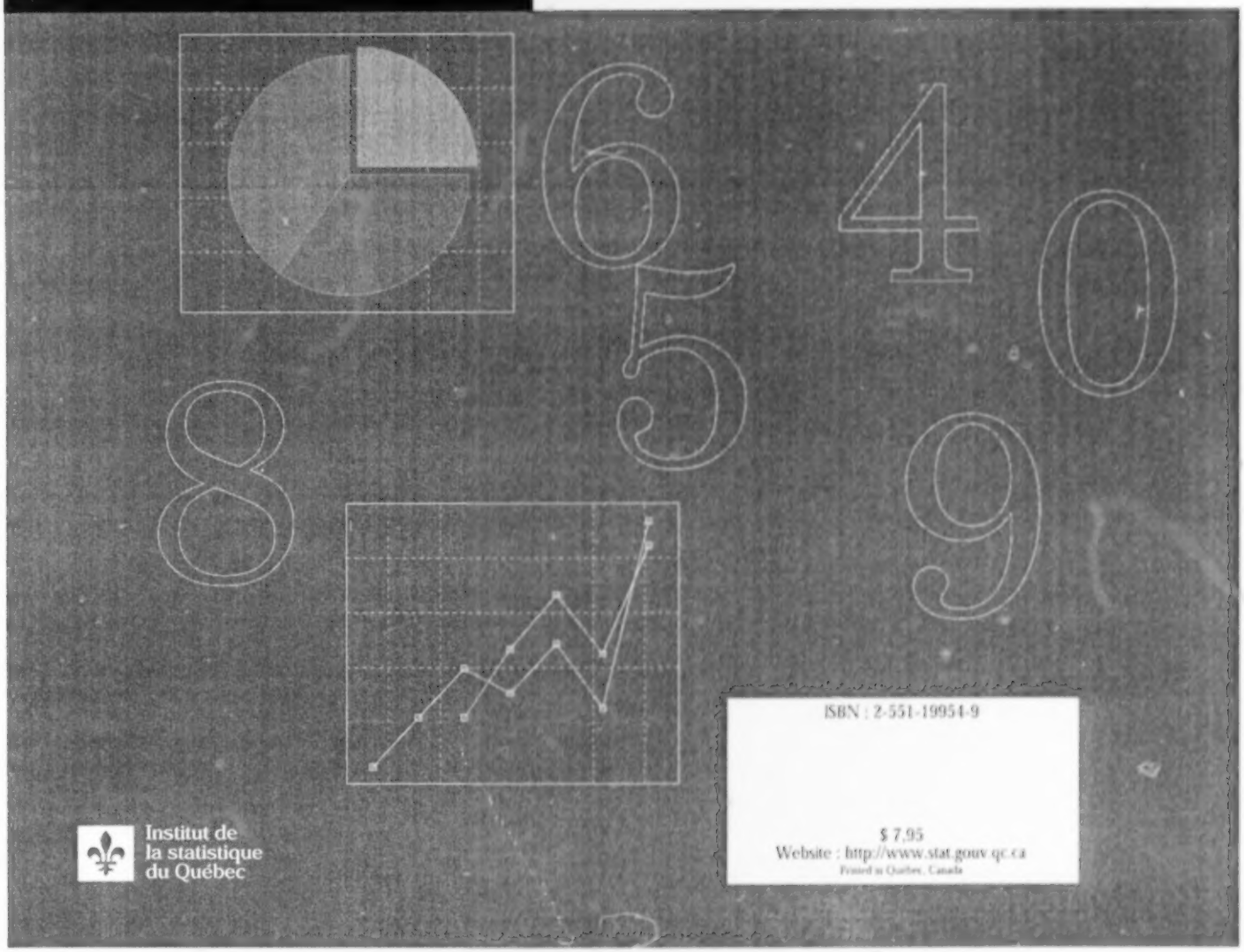
Sleep disorders in children are a major concern for parents and one of the most common problems seen in clinical pediatrics. Poor sleep has many consequences and can affect all aspects of child development. In addition to the maturation of the nervous system, parental behaviours regarding sleep, the physical sleep environment, characteristics proper to the infant, standard of living and other family characteristics can all influence sleep habits. This paper presents a portrait of the sleep-wake rhythm of Québec infants approximately 5 months of age, and indicates the factors that may impede the consolidation of nocturnal sleep. Future years of the Longitudinal Study of Child Development in Québec (ELDEQ 1998-2002) will help verify whether sleep problems identified at 5 months will have persisted. Associations between poor sleep and the physical, cognitive and social development of the child can therefore also be studied.



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